

CLAIMS

1. A cooling apparatus boiling and condensing a refrigerant, comprising:

- 5 an upper plate;
 a lower plate;
 a plurality of intermediate plates stacked
between said upper plate and said lower plate;
 a first space defined by a plurality of
apertures formed in said intermediate plates for
10 hermetically sealing a refrigerant therein;
 a second space through which an external
cooling fluid flows in proximity to said first space; and
 at least a heat-generating member mounted
on an outer surface of at least said lower plate of said
15 upper plate and said lower plate;
 wherein heat is exchanged between said
external cooling fluid and said refrigerant boiled by the
heat of said heat-generating member; and
 wherein an upper surface of said second
20 space is formed in proximity to an inner surface of said
upper plate.

2. A cooling apparatus boiling and condensing a refrigerant according to claim 1,

- 25 wherein an area where said upper surface
of said second space is in proximity to said inner
surface of said upper plate is formed in a position
corresponding to the area of said heat-generating member
which may be mounted on said upper plate.

3. A cooling apparatus boiling and condensing a
30 refrigerant according to claim 1,

 wherein a lower surface of said second
space is formed in proximity to an inner surface of said
lower plate.

4. A cooling apparatus boiling and condensing a
35 refrigerant according to claim 1,

 wherein said first space includes a
plurality of first small spaces communicating with each

other;

wherein said second space includes a plurality of second small spaces communicating with each other; and

5 wherein said first small spaces and said second small spaces are arranged to coexist with each other.

5. A cooling apparatus boiling and condensing a refrigerant according to claim 4,

10 wherein said heat-generating member includes a plurality of internal heat sources generating heat, and

 wherein said heat sources of said heat-generating member mounted on said lower plate are arranged in positions corresponding to the positions of said first small spaces.

6. A cooling apparatus boiling and condensing a refrigerant according to claim 4,

20 wherein said heat-generating member includes a plurality of internal heat sources, and

 wherein said heat sources of said heat-generating member mounted on said upper plate are arranged in positions corresponding to the positions of said second small spaces.

25 7. A cooling apparatus comprising: a multilayer structure of a plurality of plate members;

 wherein a fluid path communicating with outside through communication ports is formed in said multilayer structure of said plurality of said plate members; and

30 wherein the heat of a heat-generating member mounted on the surface of said cooling apparatus is discharged into a heat receiving medium flowing in and out by way of said communication ports and flowing in said fluid path thereby to cool said heat-generating member; and

 wherein said communication ports are

formed in the surface at the end portions of said plate members along the direction in which said plate members extend.

5 8. A cooling apparatus according to claim 7,
 wherein said communication ports are each
 formed as a rectangle with notches of the same shape in
 the same positions at the end portions of a plurality of
 adjacent ones of said plate members.

10 9. A cooling apparatus according to claim 7,
 wherein a pipe member through which said
 heat receiving medium flows is projected outward from
 each of said communication ports.

15 10. A cooling apparatus according to claim 9,
 wherein each of said pipe members is
 connected to the corresponding one of said communication
 ports through a connecting member.

20 11. A cooling apparatus according to claim 10,
 wherein each of said connecting members is
 arranged in such a manner as to cover said corresponding
 communication port and has a through hole through which
 the corresponding one of said pipe members is inserted.

 12. A cooling apparatus according to claim 11,
 wherein said through hole is circular in
 shape.

25 13. A cooling apparatus according to claim 10,
 wherein said connecting member has a
 projected portion, and said multilayer structure of said
 plurality of said plates is formed with a fitting recess
 to be fitted with said projected portion.

30 14. A cooling apparatus according to claim 13,
 wherein said connecting member is a
 tabular metal member bent into L shape to form said
 projected portion.

35 15. A cooling apparatus according to claim 10,
 wherein said multilayer structure of the
 plurality of said plate members is formed with a recess
 corresponding to the shape of said connecting member, and

said connecting member is inserted into said recess.

16. A cooling apparatus according to claim 7,
wherein said multilayer structure of the
plurality of said plate members has a refrigerant bath
5 section for storing the refrigerant therein and a heat
exchange section for exchanging heat between said
refrigerant and said heat receiving medium flowing
through said fluid path, and

wherein said refrigerant stored in said
10 refrigerant bath section is boiled and gasified by the
heat received from said heat-generating member and
discharges the latent heat of said refrigerant vapor into
said heat receiving medium flowing in said fluid path in
said heat exchange section thereby to cool said heat-
15 generating member.

17. A cooling apparatus boiling and condensing a
refrigerant, comprising:

a refrigerant bath section having a first
heat-generating member mounted on the surface thereof for
20 storing a refrigerant therein;

a refrigerant diffusion section for
diffusing said refrigerant boiled by the heat received
from said first heat-generating member; and

a heat exchange section interposed between
25 said refrigerant bath section and said refrigerant
diffusion section and including a first space
communicating with said refrigerant bath section and said
refrigerant diffusion section and through which said
refrigerant flows, and a second space through which an
30 external cooling fluid flows;

wherein said heat exchange section
includes a multilayer structure of a plurality of tabular
members having a plurality of apertures corresponding to
said first space and said second space; and

35 wherein said refrigerant bath section is
formed integrally by forging or casting.

18. A cooling apparatus boiling and condensing a

refrigerant according to claim 17,

wherein said refrigerant bath section includes at least one of a screw portion for mounting said first heat-generating member and a mounting portion for mounting a predetermined mating member.

19. A cooling apparatus boiling and condensing a refrigerant according to claim 17,

wherein said refrigerant bath section has therein a plurality of first ribs for increasing the area of heat transfer with said refrigerant.

20. A cooling apparatus boiling and condensing a refrigerant according to claim 17,

wherein the inner bottom surface of said refrigerant bath section is formed with a plurality of first depressions.

21. A cooling apparatus boiling and condensing a refrigerant according to claim 20,

wherein said first ribs are arranged in said plurality of said first depressions.

22. A cooling apparatus boiling and condensing a refrigerant according to claim 19,

wherein said first ribs are formed as concavities in such a manner as to open from the center toward the outer periphery of said refrigerant bath section.

23. A cooling apparatus boiling and condensing a refrigerant according to claim 17,

wherein said refrigerant diffusion section is formed integrally by forging or casting.

24. A cooling apparatus boiling and condensing a refrigerant according to claim 23,

wherein said refrigerant diffusion section is formed with at least selected one of a screw portion for mounting a second heat-generating member and a mounting portion for mounting a predetermined mating member.

25. A cooling apparatus boiling and condensing a

refrigerant according to claim 17,

wherein a second heat-generating member is mounted on the surface of said refrigerant diffusion section, and

5 wherein said refrigerant diffusion section has therein a plurality of second ribs extending from said second heat-generating member side toward said second space side and in contact with said heat exchange section.

10 26. A cooling apparatus boiling and condensing a refrigerant according to claim 25,

wherein said second ribs are formed as concavities in such a manner as to open to the outer periphery from the center of said refrigerant diffusion section.

15 27. A cooling apparatus boiling and condensing a refrigerant according to claim 25,

wherein said surface of said heat exchange section in contact with said second ribs is formed with a plurality of second depressions, and

20 wherein said second ribs are arranged in said plurality of second depressions.

28. A cooling apparatus boiling and condensing a refrigerant according to claim 17,

25 wherein at least selected one of said refrigerant bath section and said refrigerant diffusion section has therein a third space through which said external cooling fluid flows from said second space, and

30 wherein a sacrificial member active against said external cooling fluid is arranged on the inner surface of said refrigerant bath section or said refrigerant diffusion section having said third space.

29. A cooling apparatus according to claim 28,

35 wherein said sacrificial member formed on the inner surface of at least said refrigerant bath section of said refrigerant bath section or said refrigerant diffusion section has a porous structure.